

Large language models empowered agent-based modeling and simulation: a survey and perspectives

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Abstract

Agent-based modeling and simulation have evolved as a powerful tool for modeling complex systems, offering insights into emergent behaviors and interactions among diverse agents. Recently, integrating large language models into agent-based modeling and simulation presents a promising avenue for enhancing simulation capabilities. This paper surveys the landscape of utilizing large language models in agent-based modeling and simulation, discussing their challenges and promising future directions. In this survey, since this is an interdisciplinary field, we first introduce the background of agent-based modeling and simulation and large language model-empowered agents. We then discuss the motivation for applying large language models to agent-based simulation and systematically analyze the challenges in environment perception, human alignment, action generation, and evaluation. Most importantly, we provide a comprehensive overview of the recent works of large language model-empowered agent-based modeling and simulation in multiple scenarios, which can be divided into four domains: cyber, physical, social, and hybrid, covering simulation of both real-world and virtual environments, and how these works address the above challenges. Finally, since this area is new and quickly evolving, we discuss the open problems and promising future directions. We summarize the representative papers along with their code repositories in <https://github.com/tsinghua-fib-lab/LLM-Agent-Based-Modeling-and-Simulation>.